

FEU 09 – Equipment Maintenance and Calibration

Table of Contents

1. Scope
2. Background
3. Safety
4. Materials Required
5. Standards and Controls
6. Calibration
7. Procedures
8. Sampling
9. Calculations
10. Uncertainty of Measurement
11. Limitations
12. Documentation
13. Reference

1. Scope

- 1.1. Provides specific instructions for the verification, calibration and maintenance of instrumentation and equipment used in the Unit.
- 1.2. Encompasses a list of equipment requiring calibration, specific requirements and intervals of calibrations and performance checks.

2. Background

- 2.1. To establish the practices for documenting the examination of firearm evidence to conform to the requirements of the Department of Forensic Sciences (DFS) Forensic Science Laboratory (FSL) *Quality Assurance Manual*, the accreditation standards under ISO/IEC 17025:2017, and any supplemental standards.

3. Safety

- 3.1. All staff will follow the specific equipment User Manuals to ensure that equipment and instrumentation are used correctly and safely. The available User Manuals can be found in Qualtrax.

4. Materials Required

- 4.1. Not Applicable

5. Standards and Controls

- 5.1. Troemner certified weight sets
- 5.2. Mitutoyo certified gauge blocks

6. Calibration

- 6.1. The following instrumentation and equipment form part of the Calibration and Maintenance plan:
 - 1. Comparison Microscopes
 - 2. Stereo Microscopes
 - 3. Balances
 - 4. Calipers
 - 5. NIST Traceable Rulers
 - 6. Certified gauge blocks
 - 7. Team Fabrication Water tank
 - 8. Savage Range Systems Snail-trap
 - 9. Remote firing device
 - 10. Certified weight sets
 - 11. Leeds Spectral Vision UV Microscope
- 6.2. This list is not inclusive and may change based on the Fiscal Year procurement schedules. The Equipment Inventory spreadsheet will be updated immediately on receipt of new equipment and/or instrumentation.

7. Procedures

- 7.1. General
 - 7.1.1. The FEU will have a designated Equipment and Calibration Coordinator to provide oversight to ensure that calibrations and performance checks are done on schedule.
 - 7.1.2. It is the responsibility of the analyst to ensure that the equipment and instrumentation used during an examination functions correctly.
 - 7.1.3. All instrumentation and/or equipment will have a calibration, performance check, and maintenance interval plan.
 - 7.1.4. The following equipment or instrumentation user manuals will be readily available electronically, physically, or both:
 - 7.1.4.1. Comparison microscopes
 - 7.1.4.2. Leeds Spectral Vision UV Microscope

7.1.4.3. Stereo microscopes

7.1.4.4. Balances

7.1.4.5. Digital calipers

7.2. Traceability

7.2.1. The FEU instruments and equipment used for forensic examinations are uniquely identified with serial numbers and, when applicable, unit tag numbers.

7.2.2. The equipment information is maintained in the Equipment Inventory spreadsheet on the FSL network drive, and includes make, model, serial number and unit tag, if applicable, and location in the laboratory, which will indicate assignment to an analyst.

7.2.3. Equipment used in casework will be recorded in case notes. All equipment used will be traceable to the relevant examination performed.

7.2.4. Hard copies of service, calibration, and maintenance records are maintained in the laboratory in the Equipment Maintenance binder.

7.3. Calibration, Performance Checks and Maintenance Intervals

7.3.1. The FEU is responsible for conducting internal performance checks on instrumentation and equipment at DFS and the COOP Site (if COOP Site is active).

7.3.2. All internal performance checks will be performed at the DFS Site by the analysts and assessed by the FEU Equipment and Calibration Coordinator.

7.3.3. COOP Site equipment calibrations will be performed by an external vendor as needed and not part of the annual calibration schedule or quarterly performance checks performed internally.

7.3.4. The Equipment and Calibration Coordinator will conduct assessments as required to ensure that calibration and performance checks are conducted on schedule.

7.3.5. The Laboratory uses outside vendors to perform calibrations on an annual or as-needed basis. Calibration certificates will be received, reviewed and signed off by FEU management or designate prior to any invoice being paid.

7.3.6. Vendors will have and will apply a procedure to estimate the uncertainty of measurement for all calibrations certificates.

7.3.7. The calibration certificates will include accreditation requirements and include a serial number, unique identifier, coverage factor, measurement uncertainty and tolerance.

7.3.8. The FEU maintains an Equipment Maintenance Schedule spreadsheet for recommended service and calibration of equipment on the FSL network drive. This schedule is a guideline for ensuring that equipment is properly maintained and remains in service.

7.3.9. The following items of equipment do not require periodic calibration:

7.3.9.1 Steel rulers are calibrated before being placed into service and that calibration remains valid unless the ruler is damaged. If a ruler is damaged, it will be taken out of service.

7.3.9.2 Trigger pull weights are not required to be calibrated before being placed into service.

7.3.10. Calibration

Calibrations are performed by an external vendor on an annual or as-needed basis. COOP site equipment will be calibrated before use, if the COOP site is active. The following items of equipment are to be calibrated:

7.3.10.1 Comparison Microscopes

7.3.10.2 Digital Balances

7.3.10.3 Calipers

7.3.11. Performance checks are performed quarterly by each analyst, for all equipment that is in service. For equipment not assigned to an analyst, performance checks are performed by the FEU Equipment and Calibration Coordinator or designee.

7.3.11.1 Comparison microscopes used for land and groove measurements will be checked by using NIST traceable stage micrometers and/or software.

7.3.11.1.1 **Comparison Microscopes- with stage micrometer:** Ensure that the microscope has a crosshair eyepiece and turn the microscope on; turn the stage micrometer on, place the Mitutoyo gauge block flat on the stage with the micrometer, and bring it into focus at any magnification. Align one edge of the gauge block with the horizontal axis of the crosshair and zero the micrometer. Measure the gauge block along the length of the side of the block marked .500in, by moving the stage up or down to align the horizontal axis of the crosshair with the opposite edge of the gauge block. Record the absolute value reading of the micrometer (in inches) in the applicable tab of the spreadsheet. Take four measurements, zeroing the micrometer in between each measure. Based on the calculated average of the measurements, and the acceptable range indicated on the log, record whether the micrometer passes (P) or fails (F) in the log.

7.3.11.1.2 **Comparison Microscopes- with calibrated software:** Turn the microscope on, open the Leica Application Suite (LAS) software, and adjust both stage objectives to the same magnification. Check that the objective magnification is correct within the software under "Acquire", by selecting the "Mic1" tab, and selecting "Objectives". Place the Mitutoyo gauge block flat on the left stage, and bring it into focus within the Leica Application Suite software. Under "Basic

Annotations”, select the “Show” check box under “Line”. Then select “Distance Line”. Measure the gauge block by using the cursor to draw a line along the length of the side of the block marked .500in. Record the value of the measurement (in inches) displayed on the screen in the applicable tab of the spreadsheet. Take four measurements, deleting (zeroing) the displayed value in between each measure. Based on the calculated average of the measurements, and the acceptable range indicated on the log, record whether the calibrated software passes (P) or fails (F) in the log.

7.3.11.2 **Digital calipers:** Turn the caliper on and zero with the jaws completely closed. Using the Mitutoyo gauge block, measure the length of the side of the block marked .500 in. Record the reading of the caliper (in inches) in the applicable tab of the spreadsheet. Take four measurements, zeroing the caliper in between each measure. Based on the calculated average of the measurements, and the acceptable range indicated on the log, record whether the caliper passes (P) or fails (F) in the log.

7.3.11.3 **Balances:** Turn the balance on and zero with the stage completely clear. Using the Troemner 1g weight and small tweezers, place the weight anywhere on the stage. Record the reading of the balance (in grams) in the applicable tab of the spreadsheet. Repeat the measurement four times, zeroing the balance in between each measure. Then using the Troemner 100g weight and large tweezers, place the weight anywhere on the stage. Record the reading of the balance (in grams) in the applicable tab of the spreadsheet. Take four measurements, zeroing the balance in between each measure. Based on the calculated average of the measurements, and the acceptable range indicated on the log, record whether the balance passes (P) or fails (F) for both weights in the log.

7.3.12. Pass/Fail

7.3.12.1. The results of any calibration or check must be documented.

7.3.12.1.1. Acceptable ranges are recorded on the applicable Performance Check spreadsheet.

7.3.12.1.2. Unacceptable ranges are recorded on applicable Performance Check spreadsheet and the equipment or instrumentation is taken out of service. Notify the Equipment and Calibration Coordinator who will contact the manufacturer/vendor to resolve the problem. The equipment or instrumentation must pass calibration or performance check before being placed back into service.

7.3.12.2 Any instrumentation or equipment taken out of service will be documented on the Equipment Inventory spreadsheet, labeled with

an “Out of Service” sign, and if applicable, removed from analysts’ work area.

- 7.3.12.2.1 Equipment or instrumentation taken out of service will have recorded, at a minimum: the unique identifier of the equipment, the dates out of service and returned to service, if applicable, as well as the reason for being taken out of service, and corrective action done, if applicable.

7.3.13. General Maintenance

Maintenance for the following equipment is typically performed by the manufacturer or authorized contractor on an annual or as-needed basis or if required.

7.3.13.1 Stereo Microscopes

7.3.13.2 Water recovery tank

7.3.13.3 Savage Range System

7.3.13.4 Remote firing device

7.3.13.5 Fume Hoods

7.3.13.6 Leeds Spectral Vision UV Microscope

7.3.13.7 Cleaning and in-house maintenance on the water recovery tank is performed monthly and recorded on the Bullet Recovery Water Tank Maintenance Log (FEU-LOG-02).

7.3.13.8 Safety eyewashes and shower within the FEU are also checked by the Health & Safety Coordinator. Eyewashes are checked weekly and the shower is checked monthly; these checks are recorded on the Eyewash and Shower Check Log, located on the Firearms network drive. All other maintenance for these is the responsibility of Department of General Services (DGS).

7.4. Reference Standards

- 7.4.1. The FEU maintains reference standards for the internal performance checks of calibrated equipment as per Section 5 of this procedure.
- 7.4.2. These reference standards are calibrated externally according to the schedule for equipment calibration, and additionally as needed. External calibrations of reference standards must be NIST-traceable.
- 7.4.3. The weight set is used for performance checks of the calibrated balances, and either gauge block is used for performance checks of the calibrated digital calipers and stage micrometers.
- 7.4.4. The serial number of the reference standard used for each performance check is recorded on the applicable Performance Check spreadsheet for each item of equipment.

8. Sampling

8.1. Not Applicable

9. Calculations

9.1. Not Applicable

10. Uncertainty of Measurement

10.1. Not applicable

11. Limitations

11.1. Not applicable

12. Documentation

12.1. Performance Check spreadsheets

12.2. DFS FEU Equipment Maintenance Schedule spreadsheet

12.3. Equipment Inventory spreadsheet

13. References

13.1. Forensic Science Laboratory Quality Assurance Manual (Current Version)

13.2. DFS Departmental Operations Manuals (Current Version)

13.3. Leeds Spectral Vision Imaging User Guide – Leeds Forensic Systems

13.4. Discovery Z – firearms and toolmarks comparison microscope Instruction manual - Leeds Forensic Systems

13.5. Leeds LCF Firearms Comparison Systems Instructions - Leeds Forensic Systems

13.6. Leica FS M Operating Manual – Leica Microsystems

13.7. Leica FS C. Leica FS CB Leica FS4000 Operating manual – Leica Microsystems

13.8. Leica DMC Operating Manual – Leica Microsystems

13.9. Leica M-series Manual – Leica Microsystems

13.10. Leica UFM4 Universal Forensic Microscope Instructional Manual – Leica Microsystems

13.11. Leica Stereo Zoom Manual – Leica Microsystems

13.12. Cavitator Ultrasonic Cleaners Instruction Manual – Mettler Electronics Corp.

13.13. Stereostar Zoom Stereoscopic microscope – Reichert - Jung